Septicemia Due to *Arthrobacter* Species in a Neutropenic Patient with Acute Lymphoblastic Leukemia

Patients with neutropenia are susceptible to various bacterial and fungal infections, and the infections may be caused by the normal nonpathogenic bacterial flora of the skin and mucous membranes, or by environmental flora. *Arthrobacter* strains with relatively low pathogenic potential are widely distributed in the environment, especially in soil [1]. It was only recently that *Arthrobacter* species were isolated from patients who did not have severe neutropenia [2, 3]. Herein we describe a neutropenic adult with acute lymphoblastic leukemia (ALL) and *Arthrobacter* species sepsis.

A 48-year-old male patient with B-lineage acute lymphoblastic leukemia that was diagnosed in February 1995 and had been in continuous complete remission, was admitted to the hospital for chemotherapy on 25 September 1996. At that time, the WBC count was 3.6×10^9/L with 38% segmented forms. Chemotherapy with etoposide 100 mg/($m^2 \cdot d$) for 2 days and cytosine arabinoside 1 g/m^2 b.i.d. for 6 doses was administered on 26 September, and rhG-CSF (recombinant granulocyte colony-stimulating factor) 300 μg/d was given 24 hours after the completion of chemotherapy. On 5 October, fever (temperature, to 39.2°C) developed and acute periodontitis was noted; physical examination did not detect any other signs of infection, including infection at the Port-A-Cath (Bard Access Systems, Salt Lake City, UT) site. The WBC count was 0.2×10^9/L with an absolute neutrophil count of 0.02×10^9/L. Intravenous piperacillin, 2 g q.i.d., and amikacin, 400 mg b.i.d., were instituted empirically, immediately after sampling of two cultures of blood by using the BACTEC NR860 analysis system (Becton Dickinson, Cockeysville, MD), one blood sample was drawn from the Port-A-Cath and the other was from peripheral blood.

A whitish-gray diphtheroid-like, gram-positive rod was isolated from both blood cultures. The organism was initially reported as *Corynebacterium aquaticum,* but was later identified as an *Arthrobacter* species. After 24 hours of incubation on sheep blood agar plates at 37°C, colonies of the patient's blood culture isolate were >2 mm in diameter, whitish-grayish, convex, and creamy. Gram staining of the isolate showed nonbranching, irregular, asporogenous, short, gram-positive rods. The isolate was catalase-positive, nonmotile, and exhibited an oxidative metabolism. Nitrate reduction was negative but urease and esculinase activities were detected. The isolate did not produce acid from glucose, maltose, sucrose, mannitol, or xylose, but it utilized many different carbohydrates. Results of a CAMP (Christie, Atkins, Munch, and Petersen) reaction were negative. The diamino acid of the cell wall was lysine, as determined by the method of Schaal [4]. Using the Sherlock system (Microbial ID, Inc., Newark, DE), $C_{15:0ai}$ (49%), $C_{15:0i}$ (19%), and $C_{17:0ai}$ (13%) were found to represent the major cellular fatty acids. This combination of biochemical and chemotaxonomic characteristics unambiguously identified the isolate as *Arthrobacter* species [5].

MICs of antimicrobial agents for the strain, determined by using broth microdilution with Mueller-Hinton medium, were as follows: amikacin, 8 μg/mL; ampicillin, 4 μg/mL; cephalothin, 32 μg/mL; chloramphenicol, 2 μg/mL; clindamycin, 4 μg/mL; erythromycin, 2 μg/mL; moxalactam, >32 μg/mL; oxacillin, >16 μg/mL; penicillin, 2 μg/mL; piperacillin, 4 μg/mL; and vancomycin, 1 μg/mL. Intravenous vancomycin, 1 g b.i.d., was added on 7 October. The fever persisted until 14 October, when hypothermia (temperature, 35°C) occurred, associated with a heart rate of 50–60 beats/minute, blood pressure of 90/60 mm Hg, but no acute distress. Normal vital signs were regained on 16 October. The patient had received a 14-day course of each antibiotic and the absolute granulocyte count increased to 0.56×10^9/L with complete resolution of periodontitis. The patient was discharged from the hospital in good condition on 24 October without removal of the Port-A-Cath.

Recently, *Arthrobacter* strains have been isolated from blood, urine, and sites of skin infection, vaginitis, and endophthalmitis. Clinical information was available for only two cases [2, 3]. There had been foreign body implantation in both cases, one with a Port-A-Cath and the other with an intraocular lens. Unlike the present case, neither was associated with severe neutropenia. All three cases recovered from arthrobacter infection after appropriate antibiotic treatment without removal of the foreign devices.

Our case was initially misdiagnosed as *C. aquaticum* infection by using API (RAPID) Coryne system (bioMérieux, Marcy l'Etoile, France) for identification. Chemotaxonomic investigations (e.g., cell wall analyses) must be performed for the identification of some coryneform bacteria. However, these techniques are reserved for the reference laboratory. We believe that *Arthrobacter* strains would be reported more frequently if the species or genus of clinically significant coryneform bacteria was determined more regularly. This case emphasizes *Arthrobacter* species as a potential pathogen in patients with neutropenia. Sepsis due to *Arthrobacter* species should be treated according to the antibiogram; removal of the implanted devices is not always necessary.

Cheng-Lung Hsu, Lee-Yung Shih, Hsieh-Shong Leu, Chu-Lan Wu, and Guido Funke

Divisions of Hematology-Oncology and Infectious Diseases, Department of Internal Medicine, and Department of Clinical Pathology, Chang Gung Memorial Hospital, Taipei, Taiwan; and the Department of Medical Microbiology, Zürich University Hospital, Zürich, Switzerland

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Reprints or correspondence: Dr. Lee-Yung Shih, Division of Hematology-Oncology, Department of Internal Medicine, Chang Gung Memorial Hospital, 199 Tung-Hwa North Road, Taipei, Taiwan.

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Mechanism of Cross-Contamination of Blood Culture Bottles in a Pseudoepidemic of *Enterobacter cloacae* Bacteremia

From 3 January 1995 to 4 February 1995, *Enterobacter cloacae* was isolated from 45 cultures of blood obtained from 40 patients who were admitted to the emergency department of the Rambam Medical Center (Haifa, Israel). An extensive investigation clearly demonstrated that the outbreak was caused by cross-contamination of blood culture bottles. Herein we describe the methods that were used to determine the source and mechanism of contamination involved in this pseudoepidemic.

An extensive epidemiologic investigation was begun on 10 January 1995. After 20 days, all surveillance culture sources were negative for *E. cloacae.* By this time, a review of the emergency department laboratory practices revealed that in December 1994, a new type of a commercially manufactured tube containing lithium and heparin was introduced for exclusive use in the emergency department. All 20 tubes tested contained *E. cloacae,* with quantitative cultures yielding $\leqslant 6 \times 10^5$ cfu/mL. The entire batch of tubes was discarded and, since then, no new cases of *E. cloacae* bacteremia have been detected. We then performed mock experiments to observe the techniques used for inoculating blood culture bottles.

After informed consent was obtained, blood was drawn for cultures, by using three different techniques, from patients hospitalized for any reason other than fever or infection. Blood was aspirated aseptically from each patient into a sterile, 10-mL syringe via a 21-gauge needle, which was then aseptically substituted for a similar new needle. In technique A, 5 mL of the blood specimen was introduced into a blood culture bottle and the remaining 2 mL of blood was introduced into a test tube through the same needle. This procedure was performed for 13 patients. In technique B (15 patients), 2 mL of the blood specimen was introduced into a test tube, and the remaining 5 mL was inoculated into a blood culture bottle without changing the needle. Technique C (11 patients) was performed in the same manner as B, but the potentially contaminated needle was aseptically replaced by a similar new one before blood was inoculated into the blood culture bottle. Test tubes used in the experiment were chosen randomly from the contaminated batch. Aerobic BACTEC blood culture bottles (Becton-Dickenson, Sparks, MD), similar to those used by the microbiology laboratory, were also randomly assigned to the three groups. All blood culture bottles that were inoculated by using techniques A and C were negative. In contrast, 9 of the 15 bottles that were inoculated by using technique B (inoculation without changing the needle that was previously used to fill a blood collection tube) yielded *E. cloacae.* The relatedness of *E. cloacae* strains was determined by using a ribotyping technique [1]. Identical banding pattern was found for *E. cloacae* isolates obtained from two involved patients and one blood collection tube. This pattern was clearly distinguishable from that of the control *E. cloacae* strain.

Reports of pseudoepidemics of bloodstream infections have increased during the past 20 years [2], and some of the cases have been traced to contaminated blood collection tubes that contained sodium citrate [2–3] or thrombin [4].

Some unique features of this pseudoepidemic were clearly delineated, the first of which was the strange circumstance of an outbreak of a community-acquired infection associated with a typical nosocomial pathogen. Second, the original source of *E. cloacae* could be conclusively identified. Third, the source of contamination contained the same genotypically related strain that was isolated from cultures of blood obtained from patients involved in the outbreak. Finally, our mock transfer experiment suggests that this pseudobacteremia outbreak occurred as the result of cross-contamination of blood culture bottles that were inoculated after filling contaminated blood collection tubes. Although an outbreak such as this could be prevented by changing needles, this practice should be discouraged because of the high risk of needlestick injuries. This pseudoepidemic emphasizes the need for continuous efforts to have hospital personnel adhere to standard protocols for obtaining blood for cultures.

R. Finkelstein, E. Kassis, A. Lapidot-Farkash, I. Oren, I. Avivi, N. Hashman, G. Rabino, and E. Ben-Porat

Infectious Diseases Unit and Department of Clinical Microbiology, Rambam Medical Center, Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel

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Reprints or correspondence: Dr. R. Finkelstein, Infectious Diseases Unit, Rambam Medical Center, Haifa 31096 Israel.

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